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(56) Documents Cited
EP 0620531 A2 DE 004211189 A1 US 5543592 A
US 4952919 A US 4493992 A

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(54) Abstract Title
**A pointing device for controlling a computer application**

(57) A pointing device for providing selectively independent pulsed signal outputs to a computer for controlling the image generated and displayed by the computer, comprises a middle push button switch 2 for changing the mode of operation of the computer, and a track ball 4 movable in either direction on at least one rotary axis to generate a corresponding pulsed signal input. When the switch is not operated, the track ball controls X-Y movement of a cursor in the normal way. On a first operation of the switch, the track ball rotates about two rotary axes to provide a PAN mode, and on a second operation of the switch, the track ball rotates about one of the axes to provide a ZOOM mode. On further operations of switch 2, the two modes alternate until the switch is released by operation of one of the other switches 1, 3.

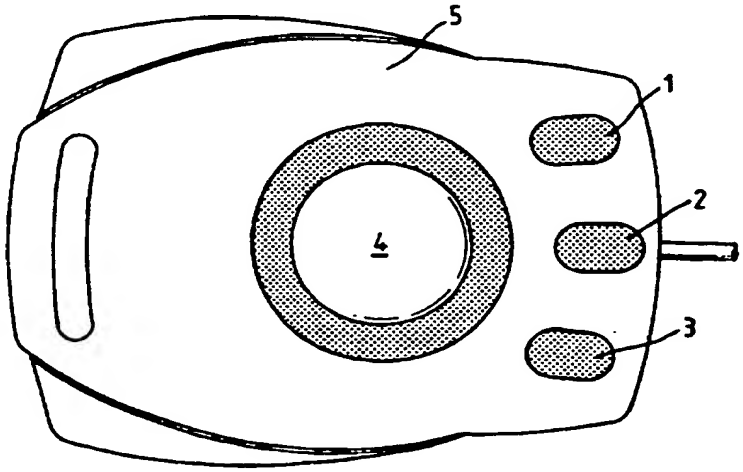


Fig. 1



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

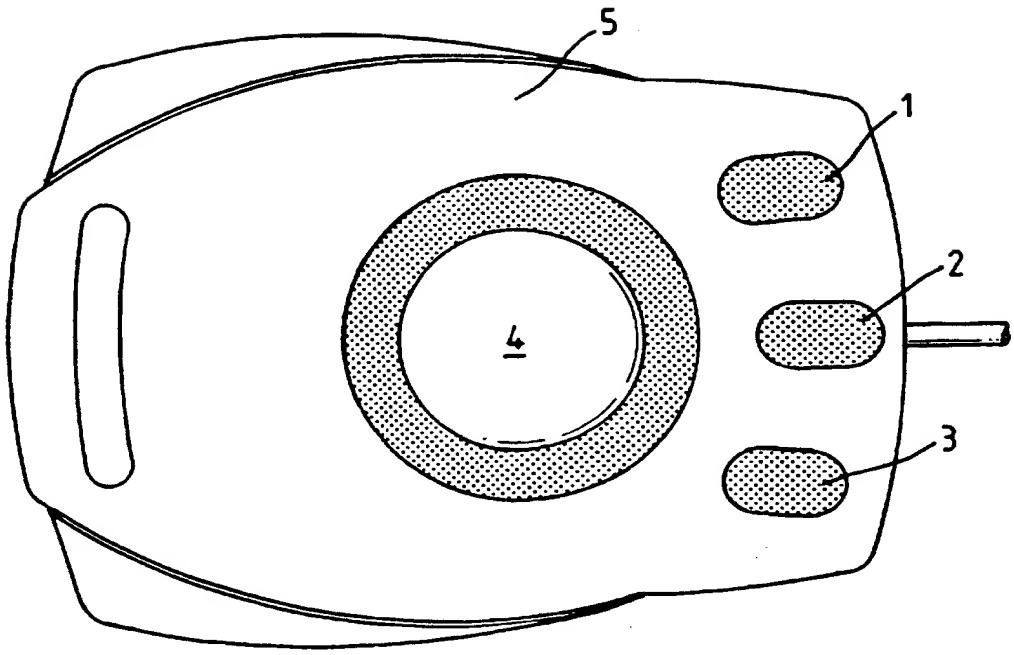


Fig. 1

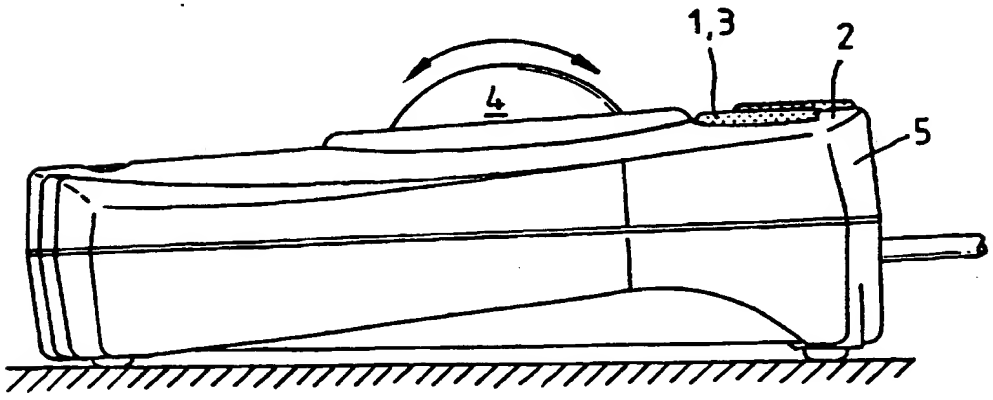


Fig. 2

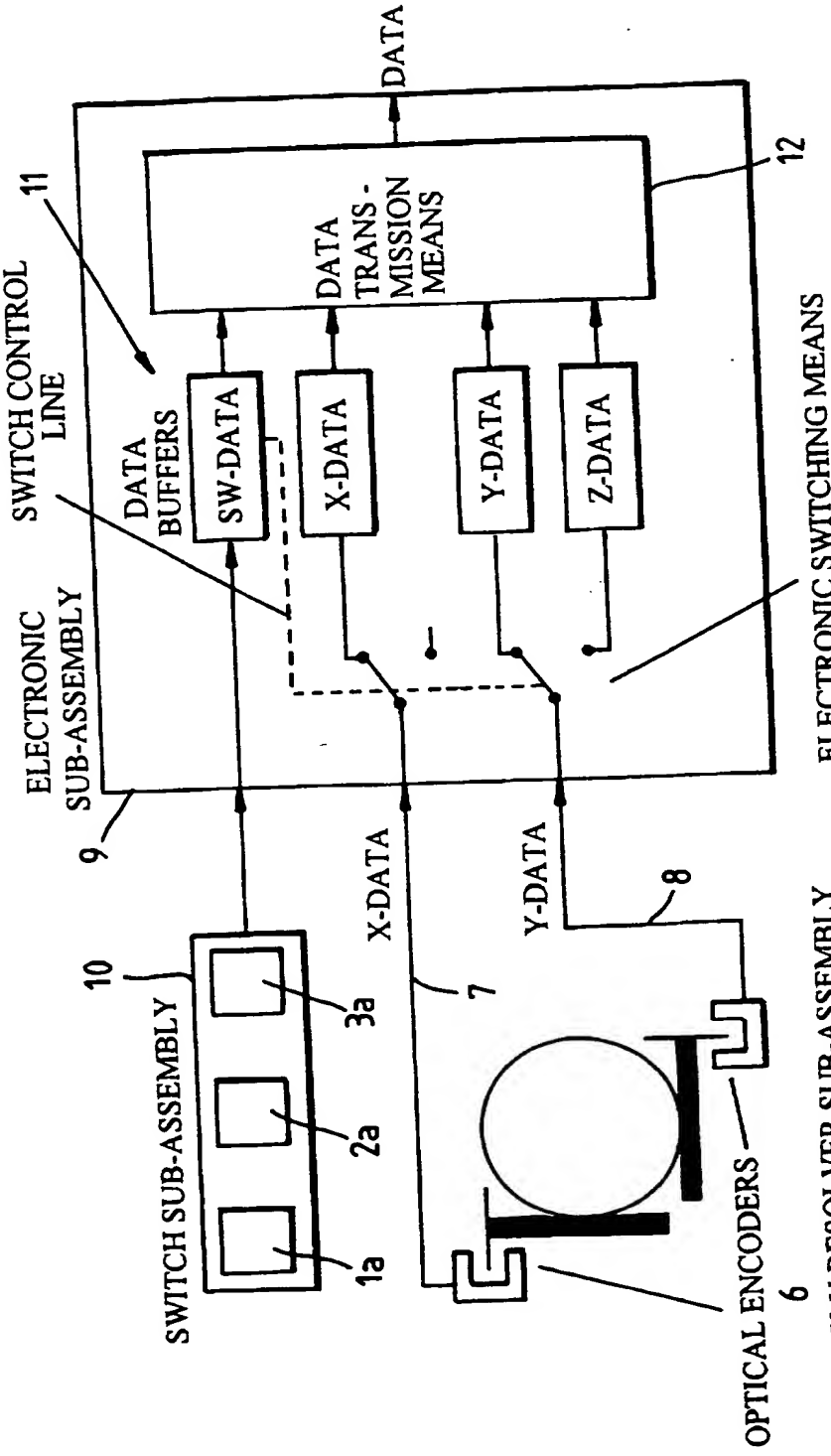
DATA
12
DATA TRANS-MISSION MEANS
11
SWITCH CONTROL LINE
DATA BUFFERS
SW-DATA
X-DATA
Y-DATA
Z-DATA
ELECTRONIC SUB-ASSEMBLY
9
ELECTRONIC SWITCHING MEANS
10
SWITCH SUB-ASSEMBLY
3a
2a
1a
X-DATA
7
Y-DATA
8
OPTICAL ENCODERS
6
X-Y RESOLVER SUB-ASSEMBLY

Fig. 3

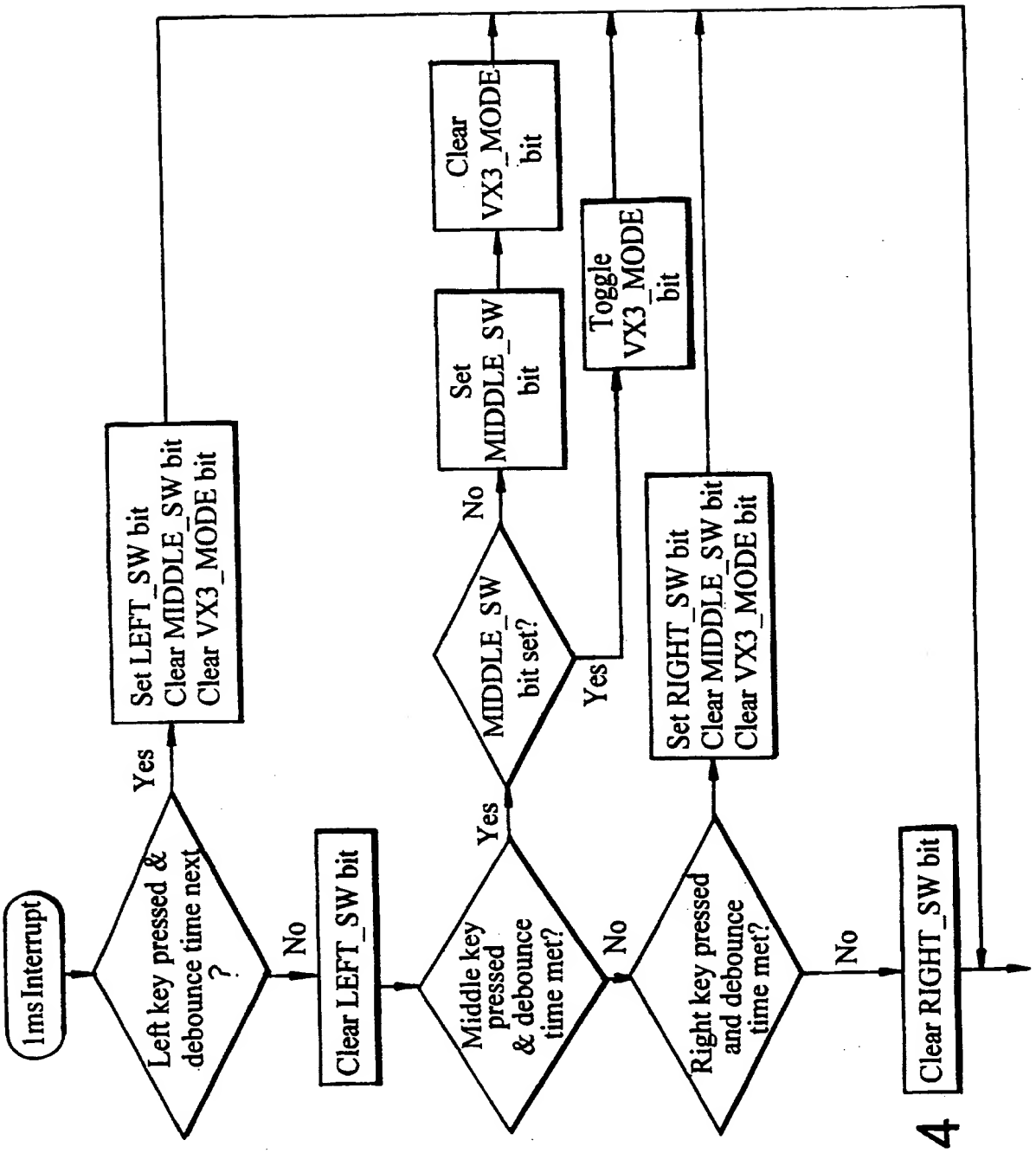
1ms Interrupt
Left key pressed & debounce time next ?
Yes
Set LEFT_SW bit
Clear MIDDLE_SW bit
Clear VX3_MODE bit
No
Clear LEFT_SW bit
Middle key pressed & debounce time met?
Yes
MIDDLE_SW bit set?
No
Set MIDDLE_SW bit
Clear VX3_MODE bit
Yes
Toggle VX3_MODE bit
No
Right key pressed and debounce time met?
Set RIGHT_SW bit
Clear MIDDLE_SW bit
Clear VX3_MODE bit
No
Clear RIGHT_SW bit

Fig. 4

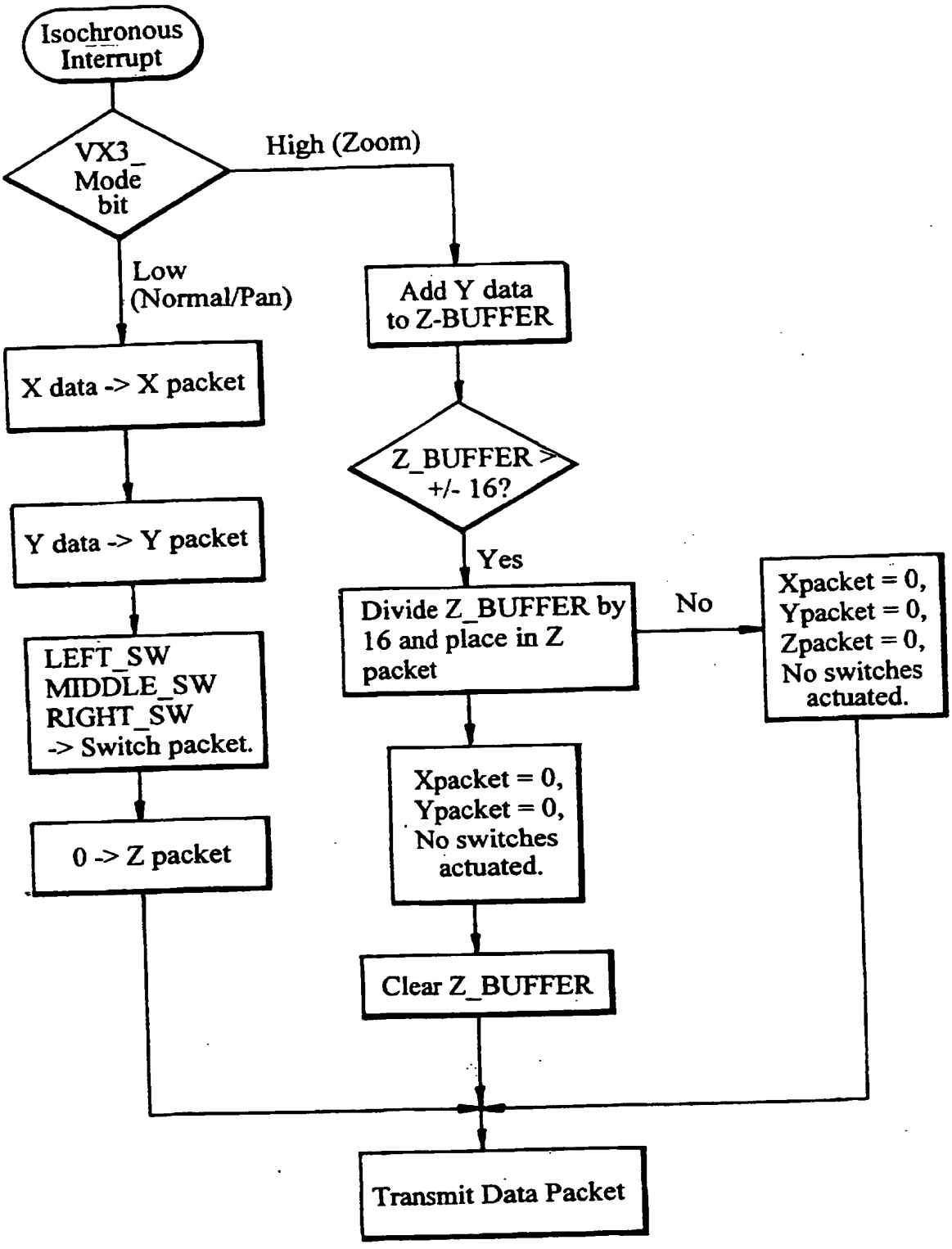
Isochronous Interrupt
VX3_ Mode bit
High (Zoom)
Low (Normal/Pan)
Add Y data to Z-BUFFER
X data -> X packet
Z_BUFFER > +/- 16?
Y data -> Y packet
Yes
No
Divide Z_BUFFER by 16 and place in Z packet
Xpacket = 0, Ypacket = 0, Zpacket = 0, No switches actuated.
LEFT_SW MIDDLE_SW RIGHT_SW -> Switch packet.
Xpacket = 0, Ypacket = 0, No switches actuated.
0 -> Z packet
Clear Z_BUFFER
Transmit Data Packet

Fig. 5

# A POINTING DEVICE FOR CONTROLLING A COMPUTER APPLICATION

This invention relates to data processing means, for example a personal computer with peripheral devices, for controlling a computer application display using a pointing device, for example a trackball device or a mouse; it also relates to such a pointing device.

Trackball pointing devices are intended to be stationary on a desk, and usually have a ball and two or three push buttons for signalling. The ball is freely movable about two perpendicular axes, and transducers in the trackball device convert these motions into signals which are then processed in the computer, using appropriate driver software. An alternative pointing device is the more common mouse which is intended to be moved in two dimensions over a mouse mat, to control motion of a ball which rolls on the mat.

Graphics-based software applications, particularly specialist three dimensional computer aided design and sophisticated word-processing packages, have produced a requirement for additional feature control in a third axis (zoom), and more forms of control in a two dimensional work space (pan and scroll). This functionality has previously been achieved only by the addition of separate and specific mechanical sub-assemblies, such as a ring and encoder couple or a specific secondary movement wheel. A hybrid mouse and a hybrid trackball device, each having an additional mechanical roller, are described for example in US-A-5446481, which also refers to an early version of a trackball device disclosed in US-A-3541521. Such devices have been used for scrolling the screen image, as an alternative to two-dimensional movement of a cursor.

These mechanical solutions to the provision of third axis functionality introduce complexity and cost and can make the pointing device less reliable.

Accordingly, the invention provides a pointing device for providing selectively at least two independent pulsed signal outputs to a computer for controlling the image generated by a computer application on a computer display, the pointing device having at least one signalling button for changing the mode of operation of the computer in response to the pulsed signals, and a rotary signalling device movable in either direction on at least one rotary axis to generate a corresponding pulsed signal input indicative of the direction and extent of rotary motion of the rotary signalling device; wherein the pointing device responds to the operation of the signalling button to switch the pulsed signal input between the two different pulsed signal outputs, thereby to select the said mode of operation of the computer.

The invention has the advantage of being compatible with conventional trackball driver software and existing computer applications. The invention can be put into effect simply by replacing the pointing device, and continuing to use an appropriate program in an existing programmed personal computer, for example a PC running Microsoft Windows 95 or Windows 98, and a three button, three axis driver program. The invention avoids the need for mechanically complex pointing devices, in effect by providing a "virtual" third axis control, providing selectively a different way of responding to rotation of the ball (or other rotary signalling device) in the alternative mode, from normal cursor movement in two dimensions in the "normal" mode, or first mode, of operation. Pan, scroll and zoom modes are all possible as alternative modes, and more than one alternative mode may be selectable.

In order that the invention may be better understood, a preferred embodiment will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figures 1 and 2 are views from above and one side, respectively, of a three-button trackball device embodying the invention;

Figure 3 illustrates the electronic components of the trackball device of Figures 1 and 2;

Figure 4 is a flow diagram showing part of the operation of electronic sub-assembly of Figure 3; and

Figure 5 is a flow diagram of another part of the operation of the electronic sub-assembly of Figure 3.

A data processing system embodying the invention comprises a computer unit such as a personal computer; a visual display unit connected to the computer unit for displaying an image on a screen; a pointing device in the form of a trackball device 5, connected by a cable to an input of the computer unit; a keyboard connected to another input of the computer unit, and applications software stored in the computer unit. Such a system is conventional and is described for example in US-A-5805161. In this example, the trackball device 5 has three signalling buttons, 1, 2 and 3, and a ball 4.

The visual display unit provides a visual representation of images created by the applications software resulting from signals provided by the user using the keyboard and/or the pointing device.

As shown in Figure 3, an X-Y resolver sub-assembly in the trackball device 5 has optical encoders acting as transducers 6 converting motion of the ball 4 on respective X and Y axes to corresponding signals 7, 8 representing X-data and Y-data

respectively. These data signals are processed in an electronic subassembly 9 in the trackball, which also responds to the signals from switches 1a, 2a and 3a for buttons 1, 2 and 3 in a switch sub-assembly 10. X-data, Y-data and Z-data derived from the Y_data by the sub-assembly 9, together with switch data SW-DATA comprising a three bit byte of LEFT-SW, MIDDLE-SW and RIGHT-SW bits representing a "software latch" status of buttons 1, 2 and 3 respectively, are stored in data buffers 11. The data buffers also store a VX3-MODE bit and a Z-BUFFER byte, whose functions are described below. Data transmission means 12 retrieves those data from data buffers 11 and outputs them along a cable to the computer unit. The connection to the computer unit is typically PS/2, RS232 or USB.

The operating system is provided with conventional resident drivers, in this case a three button, three axis trackball driver. This software responds to the data from the trackball embodying the invention to provide appropriate image control data and function control data to the operating system such as Microsoft Windows 98.

Figures 4 and 5 are scrap views of flow diagrams implemented in code. Figure 4 is part of the switch scanning and debounce routine. Its function is to control the setting/clearing of the middle switch bit MIDDLE-SW and the VX3_MODE bit. The first time the middle button 2 is pressed the trackball unit enters 'Pan' mode. This is normal X/Y operation but with the middle switch permanently pressed (latched). The application software running on the host computer recognises the middle button as indicating that Pan mode should be invoked. VX3_MODE is clear whenever the unit is in Pan mode or Normal mode:

| MIDDLE_SW BIT | VX3_MODE BIT | MODE |
|---|---|---|
| 0 | 0 | Normal |
| 0 | 1 | Illegal |
| 1 | 0 | Pan |
| 1 | 1 | Zoom |

As shown in Figure 4, a second press of the middle button keeps the middle button bit MIDDLE-SW set and sets the VX3_MODE bit. This bit indicates, through a switch control line shown in Figure 4, to the packet sorting routine of Figure 5 that the Y data should be electronically switched to the Z axis for operation in Zoom mode (so-called because many modern software applications use the Z axis to control a zoom function). The electronic switching means is thus activated, as shown in Figure 4, to send the X-data nowhere and the Y-data to the Z-data buffer.

Subsequent presses of the middle button toggle the unit between Pan and Zoom modes by toggling the VX3_MODE bit. This continues indefinitely until either the left or right buttons 1, 3 are pressed, in which case the MIDDLE-SW bit is cleared, VX3_MODE is cleared and the unit consequently resumes normal X/Y operation.

Figure 5 is the packet sorting routine. This takes the X, Y and switch data and then processes them into an X, Y, Z and switch packet ready for transmission. It is in this routine that the Y data are selectively re-routed through to the Z axis (i.e. they contain the 'electronic switching means').

The same routing is used to transmit data in Normal X/Y and in Pan modes since they differ only in that the middle switch is pressed in Pan mode. In both cases null data are transmitted in the Z byte.

Thus initial operation of the ball 4 provides normal X-axis and Y-axis movement of the cursor in the plane of the screen. This is a first (normal) mode of operation. By depressing the centre button 2 once, the device changes into a second mode of operation, which in this example is Pan mode, whereby any ball movement scrolls the viewpoint of the user in two dimensions about the (infinite) drawing workspace. In other words, the "window" displayed on the screen is part of a larger image, and the window can be moved in the plane of the screen to pan to selected portions of the larger image. Depression of the centre button 2 again causes a further change of mode, to Zoom mode, whereby up and down rotation of the ball 4, in the direction of the arrow shown in Figure 2, dynamically zooms the viewport scale, in a third axis perpendicular to the plane of the screen. Thus the size of the image is increased or decreased according to the direction of rotation of the ball about one axis. Continued depressions of the centre button 2 cause toggling of the system between the second and third modes, i.e. between Pan mode and Zoom mode. It is possible to return to the first mode, with normal X and Y movement of the cursor, by depressing either of the other buttons 1, 3.

For Zoom mode, in which the VX3_MODE bit is set high, the Y data are added to the Z-buffer, in order to provide zoom motion on the third axis as a function of up and down rolling of the ball 4. The Z buffer is then down scaled with a ratio of 16 to 1. This 16 to 1 scaling of the Y data when it is routed to the Z axis is necessary to avoid excessive Z-axis tracking rates. However, it is not possible simply to divide the Y data by 16: this would require the user to achieve a certain displacement (at least 16 pixels) between each successive data packet before any displacement would occur, i.e. it would make it speed sensitive. Instead, the Z buffer accumulates the displacement each time a packet is prepared. If the displacement is less than +/- 16 it is simply

accumulated in the Z buffer and a zero displacement is transmitted. Once the Z buffer exceeds +/- 16, it is divided by 16 and transmitted. This ensures that the Z axis is displacement sensitive and not speed sensitive.

Whilst in this example it is the Y-axis data that are selectively re-routed to the Z-axis data buffer, it could instead be the X-axis data. Other changes of this nature will occur to the skilled reader.

It will be appreciated that the invention can be used with other rotary signalling devices, such as hybrid mice, and with pointing devices which have fewer than three buttons, even just one button. Further, functions other than pan, scroll and zoom are envisaged, responsive to the motion of the rotary signalling device in a mode different from the normal cursor drive mode.

## CLAIMS

1. A pointing device for providing selectively at least two independent pulsed signal outputs to a computer for controlling the image generated by a computer application on a computer display, the pointing device having at least one signalling button for changing the mode of operation of the computer in response to the pulsed signals, and a rotary signalling device movable in either direction on at least one rotary axis to generate a corresponding pulsed signal input indicative of the direction and extent of rotary motion of the rotary signalling device; wherein the pointing device responds to the operation of the signalling button to switch the pulsed signal input between the two different pulsed signal outputs, thereby to select the said mode of operation of the computer.

2. A pointing device according to Claim 1, for providing three said independent pulsed signal outputs of X-, Y- and Z-data representative respectively of rotation of the rotary signalling device about perpendicular X- and Y-axes and of a further rotation signal, equivalent to a Z-axis signal; in which the rotary signalling device is movable about X- and Y-axes to generate corresponding pulsed signal inputs, and the pointing device is operable selectively in a normal cursor-control mode, with the pulsed signal inputs routed to X- and Y-data pulsed signal outputs and null Z-data pulsed signal output, and in a first alternative mode, with the Y-data pulsed signal input routed instead to the Z-data pulsed signal output.

3. A pointing device according to Claim 2, in which the X-data and Y-data pulsed signal outputs are null when the pointing device is in the first alternative mode.

4. A pointing device according to Claim 2 or 3, in which the pointing device responds to a first actuation of the signalling button to switch from the normal mode to the first alternative mode.

5. A pointing device according to Claim 2, 3 or 4, in which the pointing device is selectively operable in a second alternative mode, in which the pointing device outputs a signal representative of the said signalling button being latched on, for causing the said mode of operation of the computer, in response to the pulsed signal outputs, to change accordingly.

6. A pointing device according to Claim 5, in which the pointing device routes the pulsed signal inputs to the X- and Y- data pulsed signal outputs only, when in the second alternative mode.

7. A pointing device according to any preceding claim, which there is at least a second signalling button, and the pointer device responds to actuation thereof to return from the or either of the alternative mode or modes to the first, normal mode.

8. A pointing device according to any preceding claim, in which the pointer device outputs data representative of the switch status of the or each of the signalling button or buttons.

9. A pointing device according to any preceding claim, formed as a trackball device.

10. A pointing device according to any preceding claim, in which there are three said signalling buttons.

11. A pointing device according to any preceding claim, in which there is only one rotary signalling device.

12. A computer system comprising a computer unit with a display, programmed with a driver for a pointing device and with application software for generating an image on the display, and a pointing device according to any preceding claim, whose output is provided to the computer unit and processed by the driver.

13. A trackball or other pointing device substantially as described herein with reference to the accompanying drawings.

14. A computer system substantially as described herein with reference to the accompanying drawings.

**Application No:** GB 9914910.6
**Claims searched:** 1-12

**Examiner:** Peter Squire
**Date of search:** 6 November 2000

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2Y YTA YTB G4A AKS

Int Cl (Ed.7): G06K 11/18, 20

Other: Online:WPI,EPODOC,JAPIO

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X | EP 0620531 A2 | (Sony) see e.g.col.7 lines 30-41 | 1, 9, 10, 12 |
| X | US 5543592 | (Gaultier et al.) See e.g.col.3 lines 43-52 | 1, 11, 12 |
| X | US 4952919 | (Nippoldt) see e.g.col.3 lines 50-55 | 1, 9-12 |
| X | US 4493992 | (Geller) see e.g.col.6 lines 18-26 | 1, 9, 11, 12 |
| X | DE4211189 | (Ringwald) see WPI abstract acc. no.1993-321597 [41] | 1, 2, 4, 12 |

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